



U.S. DEPARTMENT OF  
**ENERGY**

**Nuclear Energy**

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# **Nuclear Energy University Programs (NEUP) Fiscal Year (FY) 2016 Annual Planning Webinar**

**Used Nuclear Fuel Disposition**

**JC de la Garza**

**NEUP Federal Point of Contact  
Office of Nuclear Energy  
U.S. Department of Energy**

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# Used Fuel Disposition Overview

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## ■ DOE Office of Nuclear Energy Mission

- The primary mission of the Office of Nuclear Energy is to advance nuclear power as a resource capable of meeting the Nation's energy, environmental, and national security needs by resolving technical, cost, safety, proliferation resistance, and security barriers through research, development, and demonstration as appropriate

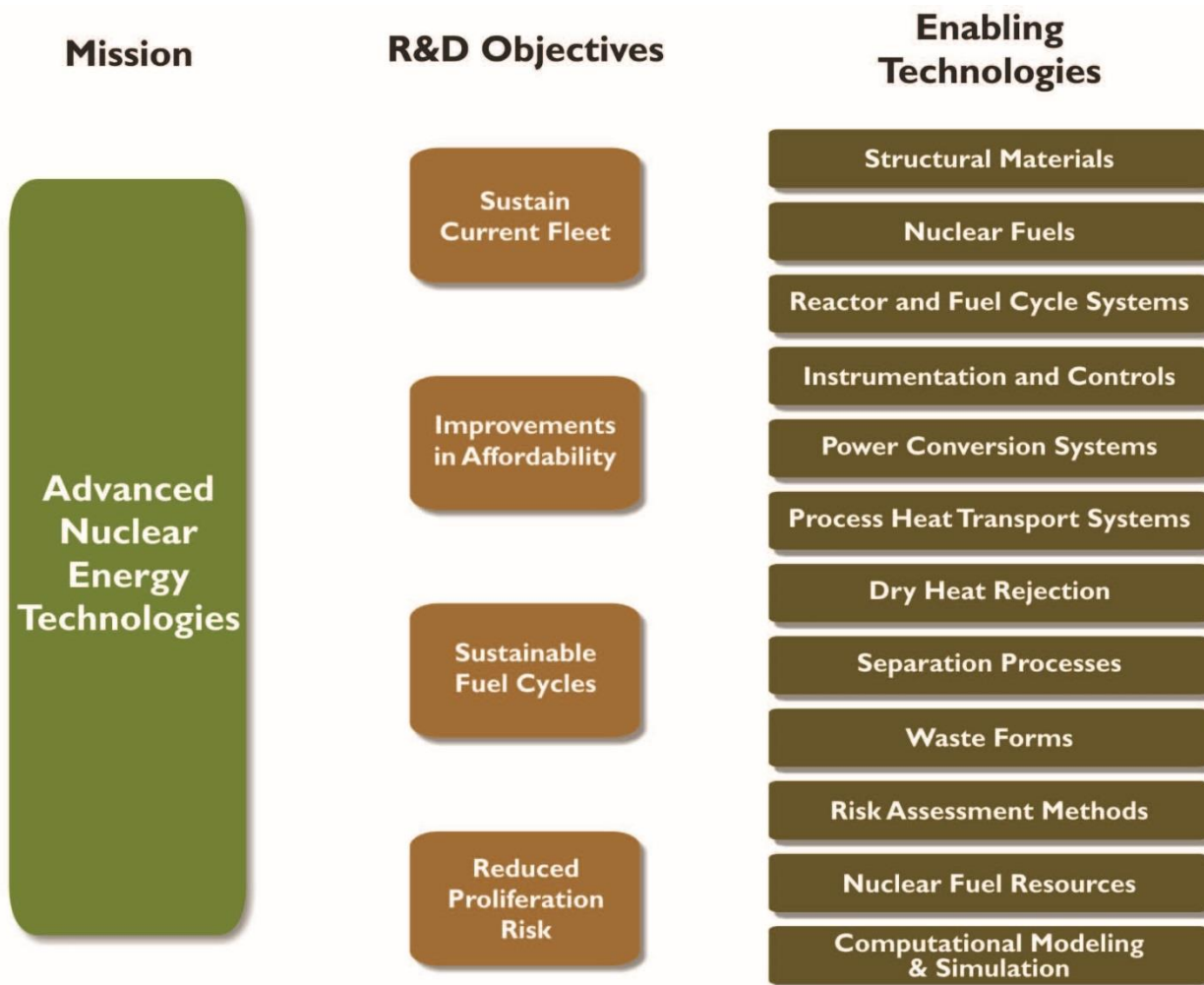
## ■ Used Fuel Disposition Mission

- The mission of the Used Fuel Disposition Campaign is to identify alternatives and conduct scientific research and technology development to enable storage, transportation and disposal of used nuclear fuel and wastes generated by existing and future nuclear fuel cycles



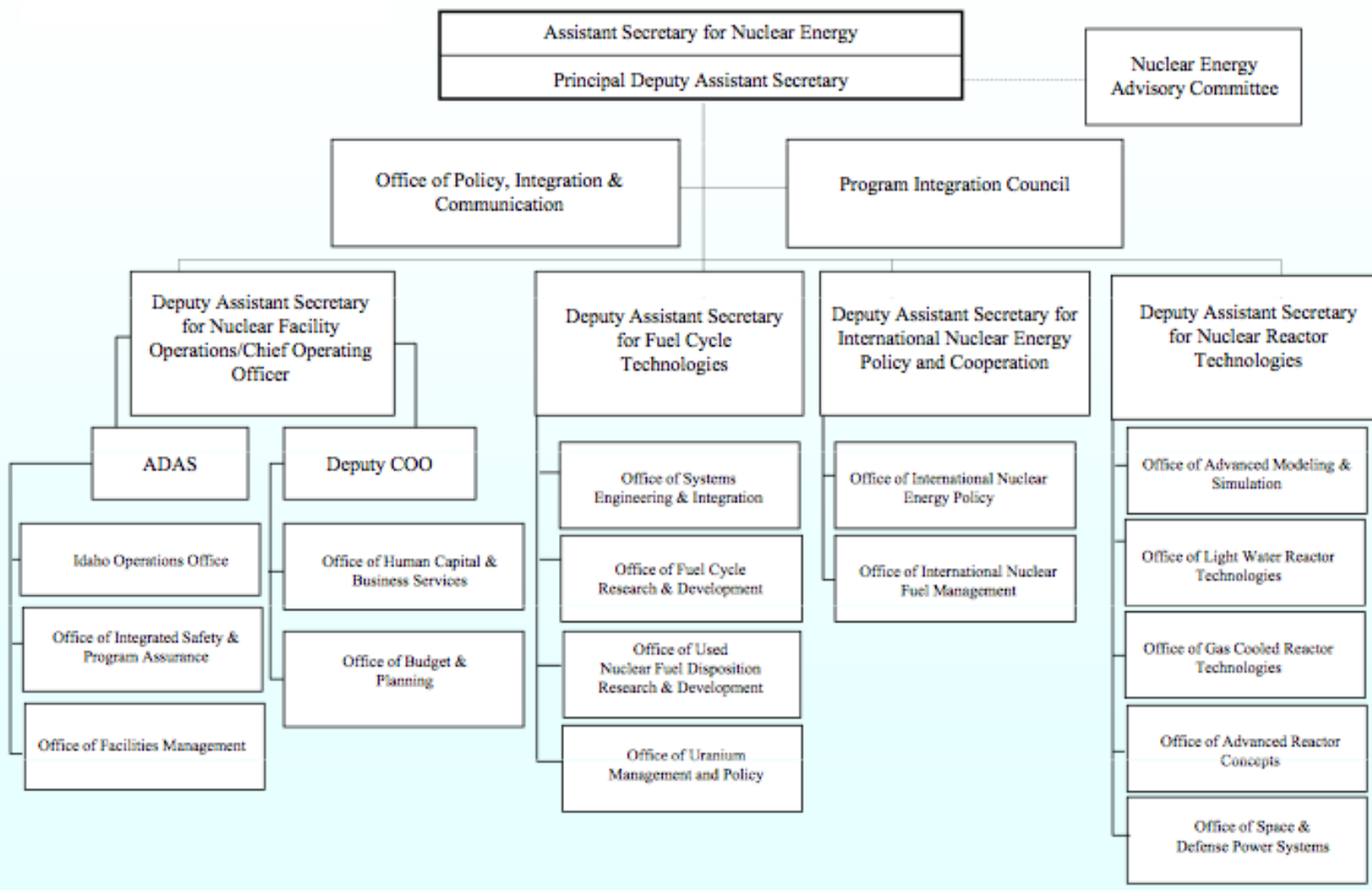
# DOE-NE Mission and Objectives

(from the 2010 DOE-NE Roadmap Report to Congress)





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# Used Fuel Disposition Campaign R&D Participants





# Grand Challenge

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- **The *Grand Challenge* for the Used Fuel Disposition Campaign is to provide a sound technical basis for the safety and security of long-term storage, transportation, and disposal of used nuclear fuel and wastes from the nuclear energy enterprise**
- **Importance: Supports the establishment of UNF management and disposition pathways**



# Used Fuel Disposition Research Needs

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## ■ Storage/Transportation

- Develop the technical bases to demonstrate used fuel integrity for extended storage periods
- Develop the technical bases for fuel retrievability and transportation after extended storage
- Develop the technical bases for transportation of high burnup fuel

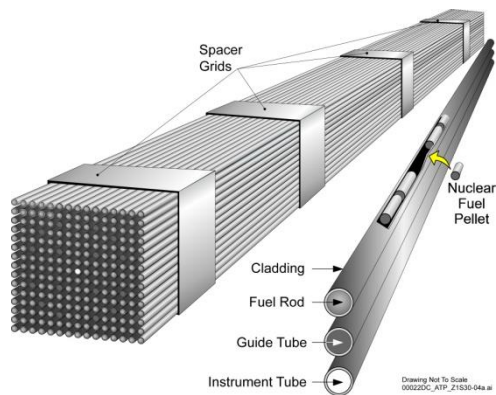
## ■ Disposal

- Provide a sound technical basis for the assertion that the US has multiple viable disposal options that will be available when national policy is ready
- Identify and research generic sources of uncertainty that challenge the viability of disposal concepts
- Increase confidence in robustness of generic disposal concepts to reduce the impact of unavoidable site-specific complexity
- Develop the science and engineering tools required to address the needs above



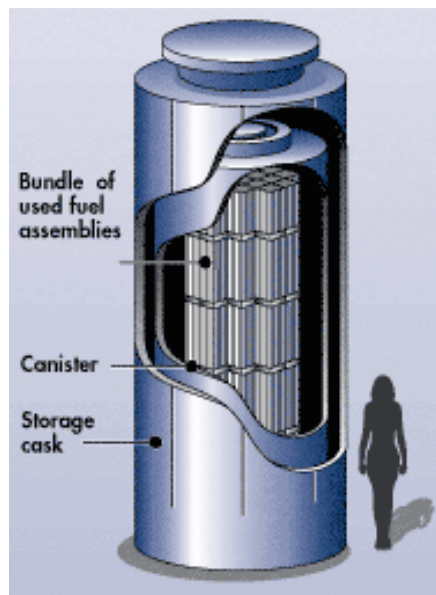
# Storage System Components

- I. Fuel**
  - I. Fuel/Pellet**
  - II. Cladding**
  - III. Assembly hardware**



## **II. Cask**

- I. Internals (baskets, neutron poisons)**
- II. Container (canister, welds, seals, bolts)**
- III. Overpack/Storage module**



## **III. ISFSI**

- I. Pad**
- II. Rebar**
- III. Physical Protection**



## **IV. Monitoring Systems**

- I. Remote inspection**
- II. In-package sensors**
- III. Security**

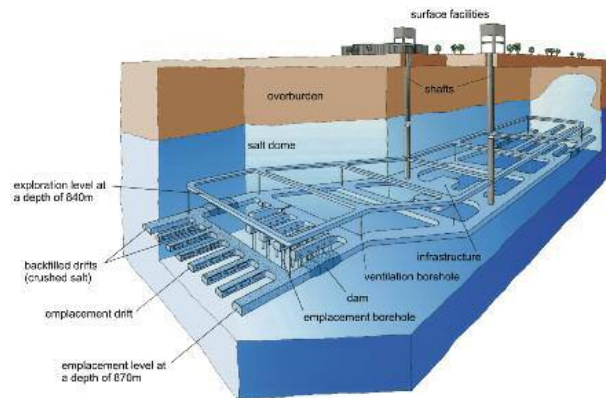
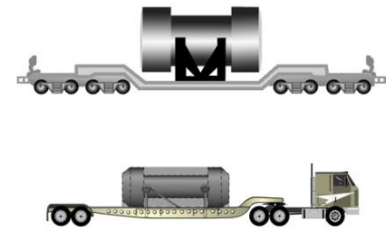




# NEUP FY 2016 R&D Work Scope

## Description: Used Fuel Disposition FC-4

- **Goals: Develop technologies for storing, transporting, and disposing of used nuclear fuel and assessing performance of waste forms in the associated storage and disposal environments**



- **Focus of the research**
  - **Storage (FC- 4.1)**
  - **Transportation (FC- 4.2)**
  - **Disposal (FC- 4.3)**



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## Used Fuel Storage (FC-4.1) Focus Areas for University Proposals

**No R&D proposals are being solicited in the Storage Area in an effort to pursue Integrated Research**



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## Used Fuel Transportation (FC-4.2) Focus Areas for University Proposals

**No R&D proposals are being solicited in the Transportation area in an effort to pursue Integrated Research**



## Used Fuel Disposal (FC-4.3) Focus Areas for University Proposals

### **Key university research needs for used fuel disposal include:**

- Improved understanding of degradation processes (i.e., corrosion and leaching) for used nuclear fuel and waste forms that could be generated in advanced nuclear fuel cycles (i.e., glass, ceramic, metallic) through experimental investigations under variable conditions of saturation, temperature, and water chemistry, leading to the development of improved models to represent these processes
- Improved understanding of the degradation processes (i.e. corrosion) for heat generating waste containers/packages considering direct interactions with buffer materials in a repository reducing environment leading to the development of improved models to represent the waste container/package long term performance
- Improved understanding of the degradation processes for engineered barrier materials (i.e., waste containers/packages, buffers, seals) and radionuclide transport processes through these materials leading to the development of improved models to represent these processes



## Used Fuel Disposal (FC-4.3) Focus Areas for University Proposals (Contd.)

### **Key university research needs for used fuel disposal include:**

- Improved understanding of coupled thermal-mechanical-hydrologic-chemical processes in the near-field of relevant disposal model environments, leading to the development of improved models to represent these processes
- Improved understanding of large-scale hydrologic and radionuclide transport processes in the geosphere of relevant disposal model environments, leading to the development of improved models to represent these processes
- Development of new techniques for in-situ field characterization of hydrologic, mechanical, and chemical properties of host media and groundwater in a borehole or an excavated tunnel
- Aqueous speciation and surface sorption at elevated temperatures and geochemical conditions (e.g., high ionic strength) relevant to the disposal environments being considered



## Used Fuel Disposal (FC-4.3) Focus Areas for University Proposals (Contd.)

### **Key university research needs for used fuel disposal include:**

- **Consideration of how specific waste forms may perform in different disposal environments using theoretical approaches, models, and/or experiments, with quantitative evaluations including uncertainties of how the long-term performance of waste forms can be matched to different geologic media and disposal concepts**
- **Experimental and modeling investigations for the effect of radiolysis on used fuel, high-level waste, and barrier material degradation at temperatures and geochemical conditions relevant to potential storage and disposal environments**
- **R&D has been undertaken in several key technical areas in the past 10 years. Applicants are encouraged to demonstrate a good understanding of work performed to date and to describe the need and importance of the research activity proposed to the demonstration of the safety case for a repository**